

# Effect of Climatological Variables on the Frequency of Incident Stroke Hospitalization During Winter

Arsalan M<sup>1\*</sup>, Lewsey J<sup>2</sup>, Inglis S<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of Physiology, NIMS University, Jaipur, India. <sup>2</sup>Associate Professor, Faculty of Medicine, Institute of Health & Well being, University of Glasgow, Scotland, U.K. <sup>3</sup>Honorary Research fellow, Institute of Cardiovascular and Medical Sciences, University of Glasgow, Scotland, U.K.

## ABSTRACT

**Introduction:** Stroke data were obtained as SMR01 (157,639 incident stroke hospitalization in Scotland between 1986-2005). **Method:** To observe variation in weather parameter, with first stroke incidences per day, during winter, daily mean temperature/total rainfall/average daily atmospheric pressure was compared with frequency of incident strokes per day using ANOVA (Analysis of Variance). **Result:** The analysis reveals an inverse statistically significant relationship for average daily temperature whereas total daily rainfall and average daily atmospheric pressure exhibit borderline significance. **Conclusion:** Correlations of low temperature with stroke might be due to concurrent infection of respiratory system.

**Keywords:** Atmospheric pressure, Climatological variables, Hospitalization, Rainfall, Stroke, Temperature, Winter

## INTRODUCTION

Stroke is defined as “abrupt impairment of brain function by a variety of pathological changes involving intracranial or extracranial blood vessels.<sup>1</sup> Prognosis after stroke seems to be very poor. Good number of people (25% to 30%) die in the initial three weeks and 33% to 66% in the 1<sup>st</sup> year following stroke incidence.<sup>2</sup> In U.K. itself about 111,000 stroke incidents are reported every year.<sup>3</sup> Yearly deaths in U.K. were reported to be 53,000.<sup>4</sup> Though there has been remarkable decline in the stroke mortality rates since 1968 a lot of variability is still present within U.K. The rates are highest in Scotland, followed by North England, Ireland, Wales and South England.<sup>5</sup>

Although overall climatological variability of stroke is appreciable in Europe and other continents like America, it is difficult to establish a specific trend due to large area-wise weather differences and pathophysiological metamorphism. The aim of the present study is to assess whether there is any association between climatological variables (temperature, rainfall and atmospheric pressure) and incidence of stroke in Scotland (1986 – 2005) during winter and suggest measures to reduce them.

## METHODS

Stroke data relate to all incident hospitalization for stroke in Scotland between 1986-2005. The data

set comprises of a sample size 157, 639 incident hospitalization. Following service divisions were kind enough to provide informations about patient’s details year-wise.

- National Health Service (NHS)
- Information Service Division (ISD)
- Scottish Morbidity Record (SMR)

SPPS (Statistical Package for Social Sciences, 15.0 versions for Windows) was used for statistical analysis.

Weather data was obtained from the Met Office- UK’s National Weather Service in the form of data sets which provide informations about average temperature, total rainfall and average atmospheric pressure on a daily basis from 1986 – 2005.

Temperature is measured at a height of 1.25 meters above ground level over a gross surface. A wide range of temperature recording is performed including air temperature, dew point, wet temperature, gross temperature and soil temperature and each is recorded using a different and specific type of thermometer. The values for temperature are noted in degree Celsius and tenths and values below 0°C are preceded by a minus sign.<sup>6</sup>

Rainfall is measured hourly, then totaled up for the daily total rainfall. The values of rainfall are noted in millimeters (mm), (25.4 mm=1 inch) (Personal reference).<sup>7</sup>

### \*Corresponding Author:

Dr. Arsalan Moinuddin, Assistant Professor, Department of Physiology, NIMS University, Jaipur, India. Mob. No. 09719445444, 09358256505, E-mail: drarsalan.moinuddin@gmail.com, drnafisahmad@rediffmail.com

Atmospheric pressure at any point on the Earth's surface is proportional to the weight of the air above it. It is measured using a precision aneroid barometer (PAB). The daily average air pressure is corrected to sea level and averaged out over the daily period 0.001 to 2400 GMT/UTS. The pressure unit used in meteorology was previously the millibar (one bar=1000 millibars). However, this has been replaced by the SI unit of pressure – the pascal (Pa) and one hectopascal (hPa)= 1 millibar (mb).<sup>8</sup>

To observe for variation in weather parameters with first stroke incidences per day during summer, daily mean values of variables were compared with frequency of incident strokes per day using ANOVA (One way analysis of variance).

Ethical approval was granted from Faculty of Medicine Ethics Committee for Non-Clinical Research involving human subjects, University of Glasgow (Project No- FM00609). The retrospective data were approved by Privacy Advisory Committee (PAC).

## RESULTS

### Winter (Temperature)

This study reveals that as the daily average temperature continues to drop by 1°C (5°C - 4°C) stroke frequency increases up to 7 strokes per day but from there onwards, a minimal variation of half °C (4°C – 4.5°C) is observed as number of strokes rises to 14 per day. The 'p' value (<0.0001) from ANOVA is highly significant and the slope of best fitted regression line ' $\beta$ ' is estimated as 0.054 which means that the average temperature decreases by -0.054 °C for each additional incident stroke increase on a given day. This support the hypothesis of an inverse statistically significant relationship ( $\beta$ = -0.054) between the number of strokes per day and daily average temperature.

### Winter (Rainfall)

This study displays a slightly wayward pattern to daily total rainfall between 3 mm and 4.5 mm throughout the increasing frequency of strokes (1-14 per day). This difference between the mean and median values of daily total rainfall is due to the skewness of observation in the data. A borderline 'p' value of 0.04 suggests some evidence of a difference in the quality of rainfall across increasing stroke value. The slope  $\beta$  of best fitted regression line is estimated as 0.084 which means that the average rainfall increases by 0.084 mm for a rise of every incident stroke on a given day. The R<sup>2</sup> value of 0.001 tells that only 0.1% of variability in stroke frequency can be explained by its dependence on rainfall. Overall evidence are not conclusive enough to establish a statistically significant relationship between stroke frequency and daily total rainfall.

### Winter (Atmospheric Pressure)

In this study the average atmospheric pressure was relatively consistent between (1010 – 1012) hPa as number of strokes rose from 1- 10 per day. A slight downward pattern is visible thereafter as number of strokes per day increases to 15 but this seems less meaningful keeping in mind the corresponding wide CI intervals due to few stroke cases. The 'p' value of 0.3 (ANOVA test) indicates that statistically non significant relation exists between daily average atmospheric pressure and number of strokes per day.

## DUSCUSSION

Temperature appears to be the only meteorological variable which showed significant variation with stroke frequency in winter. An inverse statistically significant ( $P<0.001$ ) relationship between average temperature and first incident stroke observed in present study is in accordance with a lot of studies in the past.<sup>9-11</sup>

It is assured that respiratory infections such as influenza, pneumonia, bronchitis palyed a role in the aetiology of stroke. Some evidences present that influenza causes complications in atherosclerotic disease by producing a hypercoagulable state.<sup>12</sup> Serum concentration of plasma fibrinogen enhances with lowering of temperature.<sup>13</sup> Previous report shows increased serum total cholesterol concentration (STCC) with fall in temperature.<sup>14</sup> C- reactive protein exhibits a peak during winter.<sup>15</sup>

Our study has a large sample size (151, 639) and is connected over a period of 20 years, thus the results are highly unlikely to be a product of chance. Some precautionary measures are suggested to minimize the chance of stroke i.e. protection from cold weather, decrease in alcohol consumption and maintaining blood pressure within safe range during winter season.

## REFERENCES

1. Goldman L, Bennete GL, Cecil textbook of Medicine, 21<sup>st</sup> edition, 1999 pp 2109 – 2115).
2. Ebrahim S, (1990), Clinical Epidemiology of Stroke, Oxford University Press, New York, pp 18 – 19,147,184.
3. British Heart Foundation's Statistic Website, Stroke Statistics 2009 (cited 2010 March 12). Available from <http://www.hearthstats.org/temp/chaptersp2hs2hs.pdf>.
4. British Heart Foundation's Statistics Website, Stroke Statistics 2009 (cited 2010 March 12). Available from <http://www.hearthstats.org/temp/chaptersp1.pdf>.
5. Information Service Division (ISD) Scotland Website Stroke, (cited 2010 March 12), Summary of latest publications, Available from <http://www.isdscotland.org/isd/5783.html>.
6. R Barry Hall, Climate Enquiry Officer UK Met Office outlined this information on temperature by email on Tuesday 8<sup>th</sup> June 2010 (email: [barry.r.hall@metoffice.gov.uk](mailto:barry.r.hall@metoffice.gov.uk)).

7. R Barry Hall, Climate Enquiry Officer UK Met Office outlined this information on rainfall by email on Tuesday 8<sup>th</sup> June 2010 (email: barry.r.hall@metoffice.gov.uk.).
8. R Barry Hall, Climate Enquiry Officer UK Met Office outlined this information on atmospheric pressure by email on Tuesday 8<sup>th</sup> June 2010 (email: barry.r.hall@metoffice.gov.uk.).
9. Ezevedo E, Ribeiro JA, Lopes F, Martins R, Cold HB: A risk factor for stroke ? *Journal of Neurology* 1995 April; 242 (4): pp 217-221.
10. Kojima S, Omura T, Wakamatsu W, Kishi M, Yamazaki T, Iida M and Kamachi Y; Prognosis and disability of stroke patients after 5 years in Akita, Japan, *Stroke* 1990 Jan 21 (1) pp 72-77.
11. Tsemnetizis SA, Kennet RP, Hitchcock E.R., G.U.J.S., Beevers D.G. Seasonal variations of cerebrovascular disease. *Acta Neurochirurgica*, 1991 Sept; 111 (3-4): pp 80-83.
12. Turin TC, Kita Y, Murakimi V, Rumana N, Sugihara H, Morita Y, Tomioka N, Okayana A, Nakamura Y, Abbott RD, Ueshima H. Higher stroke incidence in the spring season regardless of conventional risk factors: Takashima stroke registry, Japan, 1988 – 2001, *Stroke* 2008 Mar; 39 (3): pp 745 – 752.
13. Stout RW, Crawford V, Seasonal variations in fibrinogen concentrations among elderly people. *Lancet*- 1991 Jul 6; 338 (8758): pp 9-13.
14. Joseph TD, Sandra HK, David FB, Seasonal Variations in serum cholesterol concentration, *Journal of Chronic Disease* 1965; 18: pp 657-664.
15. Sung KC. Seasonal variation of C-reactive protein in apparently healthy Koreans. *International Journal of Cardiology*, 2006 Mar 8; 107 (3): pp 338-342.

**How to cite this article:** Arsalan M, Lewsey J, Inglis S. Effect of climatological variables on the frequency of incident stroke hospitalization during winter. *Acta Medica International* 2014;1(2):107-109.

**Source of Support:** Nil, **Conflict of Interest:** None declared.